(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 857 830 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.08.1998 Bulletin 1998/33

(51) Int Cl.[6]: **E02D 11/00**

(21) Application number: **98200418.6**

(22) Date of filing: **10.02.1998**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **10.02.1997 NL 1005236**

(71) Applicant: **HOLLANDSCHE BETON GROEP N.V.**
2285 TA Rijswijk (NL)

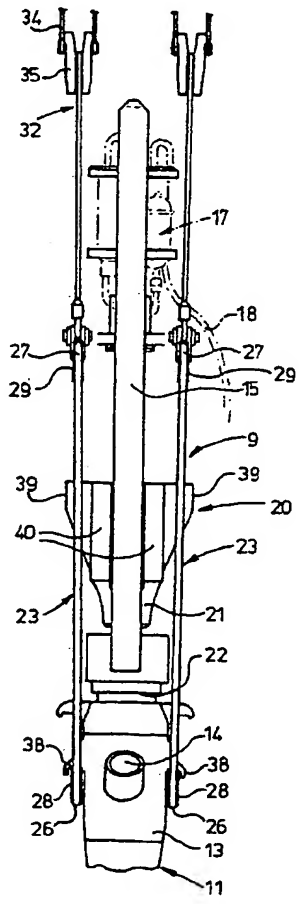
(72) Inventors:
- **Uffen, Berend Pieter René**
  4191 HC Geldermalsen (NL)
- **Lucieer, Willem Jan**
  2253 EB Voorschoten (NL)

(74) Representative: **de Bruijn, Leendert C. et al**
Nederlandsch Octrooibureau
P.O. Box 29720
2502 LS Den Haag (NL)

(54) Installation for extracting objects driven in with a piling rig

(57) An installation for extracting from the ground a slender object (11), such as a pipe, pile or sheet pile section, which has been driven into said ground comprises a hammer device with a ram (20), drive means (16) for moving the ram, striking means which have a striking face, oriented towards the slim object, for receiving blows originating from the ram (20) brought into movement by the drive means (16), and a pulling construction by means of which the striking means can be connected to the slender object. The pulling construction comprises cable means in loop form (23) which at their one end interact with the striking means and at their other end can be brought into interaction with the slender object (11).

Fig-3



EP 0 857 830 A1

Printed by Jouve, 75001 PARIS (FR)

Description

The invention relates to an installation for extracting from the ground a slender object, such as a pipe, pile or sheet pile section, which has been driven into said ground, which installation comprises a hammer device with a ram, drive means for moving the ram, striking means which have a striking face, oriented towards the slim object, for receiving blows originating from the ram brought into movement by the drive means, and a pulling construction by means of which the striking means can be connected to the slim object.

An installation of this type is disclosed in EP-A-692578. With this installation the pulling means can be constructed in the form of cables or pull rods, which at one end are fixed to a pile and at the other end are fixed to the striking means. Although the principle of this known installation is attractive, the construction using pulling cables could lead to problems in practice. The pulling cables are subjected to high dynamic loads and the connections to the pile and the striking means must be designed to cope with these.

On the other hand, the use of pulling cables is advantageous for the effectiveness of the installation. This beneficial effect has to be ascribed to the long duration of the pull stroke, which is far in excess of 5 milliseconds. If the tensile force, generated by the ram, introduced into the pile is greater than half the total shaft friction before the pile starts to be driven out by the pull it is found that, for every soil stratum, the shaft friction is excessively reduced as a result of the increase which takes place in the residual pulse and in the duration of the residual pulse after every blow by the impact device driver, as a result of which the extraction of the pile proceeds much more rapidly than expected.

The aim of the invention is, therefore, to provide an installation of the abovementioned type which can be equipped with cables in a simple and reliable manner. Said aim is achieved in that the pulling construction comprises cable means in loop form (grommets) which at their one end interact with the striking means and at their other end can be brought into interaction with the slim object.

By virtue of the fact that the cable means are in loop form, the connection to the striking means and the object can be constructed such that, on the one hand, the beneficial effects on the functioning of the installation, which have been described above, are obtained and, on the other hand, a reliable and uniform transmission of force is ensured, even under the high dynamic loads. The loop form provides the cable means with the ability to adapt to the connections to the striking means and the object in such a way that non-uniform loads can be avoided.

The cable means can comprise two steel cables, each of which has been shaped to give a cable loop consisting of two straight, essentially parallel, parts and two curved parts, which extend over a bend of essentially 180°. The ends of each steel cable can be joined to one another by means of one or more sleeve clamps.

To ensure the desired uniform transmission of forces, a cable shoe which fits closely around the cable can be incorporated in each of the curved parts. The cable shoes enable the loop to adjust such that both parts are subjected to equal loads. Furthermore, the cable shoes provide the curved parts of the cable with lateral support, so that the cable cannot be pulled flat at these locations under the high impact loads.

Preferably, each cable shoe has an essentially U-shaped outer contour and the curved parts of a cable loop are held in place by means of securing means, such as pins or bolts which extend between the two arms of the U-shaped outer contour. Especially in the case of thicker cables, which try to resume a less curved shape, it can be ensured in this way that the interaction with the cable shoes is maintained.

Each cable loop can have a striking shoe, which has an essentially flat striking face on that side thereof which faces away from the U-shaped outer contour. The bottom of the U-shaped outer contour of each striking shoe is essentially coincident with part of an imaginary circle, whilst the striking face of the striking shoe is located between the mid point of said imaginary circle and the bottom of the outer contour. A construction of this type offers the advantage that the striking shoe remains in stable interaction with the steel cable, even under the high loads which otherwise could lead to a tilting movement relative to the steel cable.

In this context the distance from the striking face to the bottom of the U-shaped outer contour, measured perpendicular to the striking face, is preferably less than or equal to the radius of said imaginary circle. In particular, the distance from the striking face to the bottom of the U-shaped cross-section can be greater than 60 % of the radius of said imaginary circle.

To ensure optimum impact transmission, the striking face is defined by a plateau which on either side adjoins recessed parts which extend as far as the outer contour of the striking shoe.

Furthermore, each cable loop has a pile shoe which can be brought into interaction with a pile or tube, which pile shoes each have a bearing surface on that side thereof which faces away from the outer contour, which bearing surface can be brought into interaction with a supporting lug provided on the pile or tube.

According to the invention the ram, together with drive means, is incorporated in a frame which is provided at the bottom with a driving cap and is guided along a leader of a mobile piling rig, in such a way that the frame with its driving cap can be positioned on the slim object, and the cable means in loop form extend from the slim object along the frame and the striking shoes are located in the path of the ram, which striking shoes are suspended from the hoisting means of the piling rig.

The installation is found to function well if the thickness of the steel cables is between 25 and 120 mm, in particular between 50 and 120 mm. Too much rotation

of the striking shoes about a vertical axis during operation, which can lead to the ram impinging incorrectly on the striking face of the striking shoe and to the cable and/or the piling rig being damaged, can be prevented by using rotation-free steel cables.

The cables in the installation can also be made up from synthetically produced threads or yarns, such as those produced from a polyamide, polyethene, polyester, polypropene or carbon or from combinations thereof. The thickness of this type of cables is between 50 and 200 mm, preferably between 100 and 170 mm.

The invention will be explained in more detail below with reference to an illustrative embodiment shown in the figures.

Figure 1 shows an installation according to the invention, constructed as a mobile pile-driving installation.

Figure 2 shows an enlarged detail of the installation according to Figure 1.

Figure 3 shows a front view of the detail according to Figure 2.

Figure 4 shows a ram or monkey as used in the installation according to Figures 1-3.

Figure 5 shows a detail with striking shoe.

The installation shown in Figure 1 comprises a mobile piling rig, which is indicated in its entirety by 1, provided with a mobile chassis 2 fitted with caterpillar tracks, as well as a cab 3 rotatably mounted thereon. A column 6 is fixed to said cab 3 in an adjustable manner by means of hydraulic cylinder-piston device 4 and 5. Both column 6 and the chassis 2 are supported on a substrate which, for example, consists of planks 7.

A leader 8 is mounted on the column 6, along which leader the frame 9, which is to be described in more detail, is slidable by means of claws 10.

By means of the piling rig 1 the tube 11 can either be driven in or extracted from the ground 12. Said tube 11 is provided at its top with a head 13 with fill opening 14 for pouring a concrete pile into the work. The frame 9 is positioned on the top end of the tube 11, as can also be seen in Figures 2 and 3. In Figures 2 and 3 the contour of the frame 9 is indicated diagrammatically by dash-and-dot lines. One of the two main uprights 15 of said frame is also shown. A hydraulic cylinder-piston device 16, together with the associated accumulator installation 17 and hydraulic lines 18, is fixed close to the top of said uprights 15. The ram or falling weight 20 is fixed to the piston rod 19 of the hydraulic cylinder-piston device 16.

The ram 20 according to the invention can be used in two ways. According to a first possibility, in which it is used as a an impact pile-driving ram, the ram 20 is moved upward by means of the hydraulic cylinder-piston device and is then released such that the nose 21 of the ram 20 is able to inflict blows on the driving cap 22 which has been placed on the top of the tube 11. In this case the installation according to the invention is functioning as an impact device driver inserting piles.

According to a second possibility, the ram can be used to extract a driven-in tube 11 from the ground. For this purpose the installation is equipped with two cable loops or grommets 23. Said grommets 23, which are made up from a single piece of cable, the ends of which have been fixed to one another by means of crimp connectors 24, comprise two essentially straight parts 25 as well as a lower part 26, which is curved through about 180°, and an upper curved part 27.

Pile shoes 28 are fixed at the lower curved portion and striking shoes 29 are fixed at the upper curved portion.

The pile shoes 28 and the striking shoes 29 possess an outward-facing essentially U-shaped slot which extends over an 180° bend. A striking shoe 29, the bottom of which is indicated by 30, is shown in Figure 5. The curved parts 27 of each grommet 23 are fitted closely in said U-shaped slot, such that they cannot be pulled flat under the influence of the tensile forces.

The curved cable sections 27, 28, which, because of the thickness of the cables used, try to assume a less curved shape, are held tightly in the U-shaped slot by means of bolts or pins 36 which extend between the two walls of said U-shaped slot.

A fixing cable 32 is fastened to the striking shoes 29, which fixing cable is connected by means of block 33 to a cable 34 which is suspended from the hoisting line 35 of the piling rig.

The pile shoes 28 located at the bottom of the grommets 23 are hooked under the lugs 38 which are welded to the pile 11.

The ram 20 has two opposing projections 39, which are positioned such that the striking shoes 29, in particular the striking face 37 thereof, are located in the path of said projections 39. The ram 20 can be accelerated upward by means of the hydraulic cylinder-piston device 16, the projections 39 ultimately each coming into contact with the striking face 37 of a striking shoe 29. The jolt generated as a result is transmitted via the cable loops 23 onto the pile 11, as a result of which said pile moves upwards.

While the blows are being struck, the cable loops 23 are continuously pulled upwards by means of the hoisting line 35 of the piling rig.

The striking face 37 of the striking shoes is preferably located some distance away from the imaginary mid point 41 of the circle which defines the bottom 30 of the U-shaped slot. This position of the striking face 37 prevents a situation where the striking shoes 29 would be able to start to tilt under the influence of the blows struck thereon by the projections 39.

The ram 20, which is shown in detail in Figure 4, is provided with guides 40 which engage, in pairs, on either side of, in each case, one main upright 15 of the frame 9.

As is shown in Figure 4, the nose 21 of the ram is

narrower than the remainder thereof. The transition between said nose 21 and said remainder proceeds fluently via a curved line; such that the force wave generated in the ram 20 generates virtually no parasitic shock waves. There is also a gradual transition from the projections 39 to those parts of the ram 20 located lower down, so that here too the generation of parasitic shock waves is prevented.

By virtue of said shaping, virtually no stress concentrations occur in the ram 20, which has a favourable effect on the life thereof.

Claims

1. Installation for extracting from the ground a slender object, such as a pipe, pile or sheet pile section, which has been driven into said ground, which installation comprises a hammer device with a ram, drive means for moving the ram, striking means which have a striking face, oriented towards the slender object, for receiving blows originating from the ram brought into movement by the drive means, and a pulling construction by means of which the striking means can be connected to the slender object, characterised in that the pulling construction comprises cable means in loop form which at their one end interact with the striking means and at their other end can be brought into interaction with the slender object.

2. Installation according to Claim 1, wherein the cable means comprise at least two cables, each of which has been shaped to give a cable loop (grommet) consisting of two straight, essentially parallel, parts and two curved parts, which extend over a bend of essentially 180°.

3. Installation according to Claim 2, wherein the ends of each steel cable are joined to one another by means of one or more sleeve clamps.

4. Installation according to Claim 2 or 3, wherein a metal cable shoe which fits closely around the cable is incorporated in each of the curved parts.

5. Installation according to Claim 4, wherein each cable shoe has an essentially U-shaped outer contour and the curved parts of a cable loop are held in place by means of securing means, such as pins or bolts which extend between the two arms of the U-shaped outer contour.

6. Installation according to Claim 4 or 5, wherein each cable loop has a striking shoe, which striking shoe has an essentially flat striking face on that side thereof which faces away from the U-shaped outer contour.

7. Installation according to Claim 6, wherein the bottom of the U-shaped outer contour of each striking shoe is essentially coincident with part of an imaginary circle, and the striking face of the striking shoe is located between the mid point of said imaginary circle and the bottom of the outer contour.

8. Installation according to Claim 7, wherein the distance from the striking face to the bottom of the U-shaped outer contour, measured perpendicular to the striking face, is less than or equal to the radius of said imaginary circle.

9. Installation according to Claim 8, wherein the distance from the striking face to the bottom of the U-shaped cross-section is greater than 60 % of the radius of said imaginary circle.

10. Installation according to Claim 6, 7, 8 or 9, wherein the striking face is defined by a plateau which on either side adjoins recessed parts which extend as far as the outer contour of the striking shoe.

11. Installation according to one of Claims 6-10, wherein each cable loop has a pile shoe which can be brought into interaction with a pile or tube, which pile shoes each have a bearing surface on that side thereof which faces away from the outer contour, which bearing surface can be brought into interaction with a supporting lug provided on the pile or tube.

12. Installation according to one of Claims 6-11, wherein the ram, together with drive means, is incorporated in a frame which is provided at the bottom with a driving cap and can be guided along a leader of a mobile piling rig, in such a way that the frame with its helmet can be positioned on the slim object, and the cable means in loop form extend from the slim object along the frame and the striking shoes are located in the path of the ram, which striking shoes are suspended from the hoisting means of the piling rig.

13. Installation according to Claim 12, wherein the ram has two opposing projections and the cable means comprise two cable loops (grommets), such that the projections on the ram reach into the cable loops.

14. Installation according to one of the preceding claims, wherein the cables are steel cables, the thickness of which is between 25 and 120 mm.

15. Installation according to Claim 14, wherein the thickness of the steel cables is between 50 and 120 mm.

16. Installation according to Claim 14 or 15, wherein the

steel cables are rotation-free.

17. Installation according to Claims 6-13, wherein the cables are made up from synthetically produced threads or yarns, such as of a polyamide, a polyethene, a polyester, a polypropene or a carbon or from combinations thereof and wherein the thickness of the cables is between 50 and 200 mm.

18. Installation according to Claim 17, wherein the thickness of the cables is between 100 and 170 mm.

Fig - 1

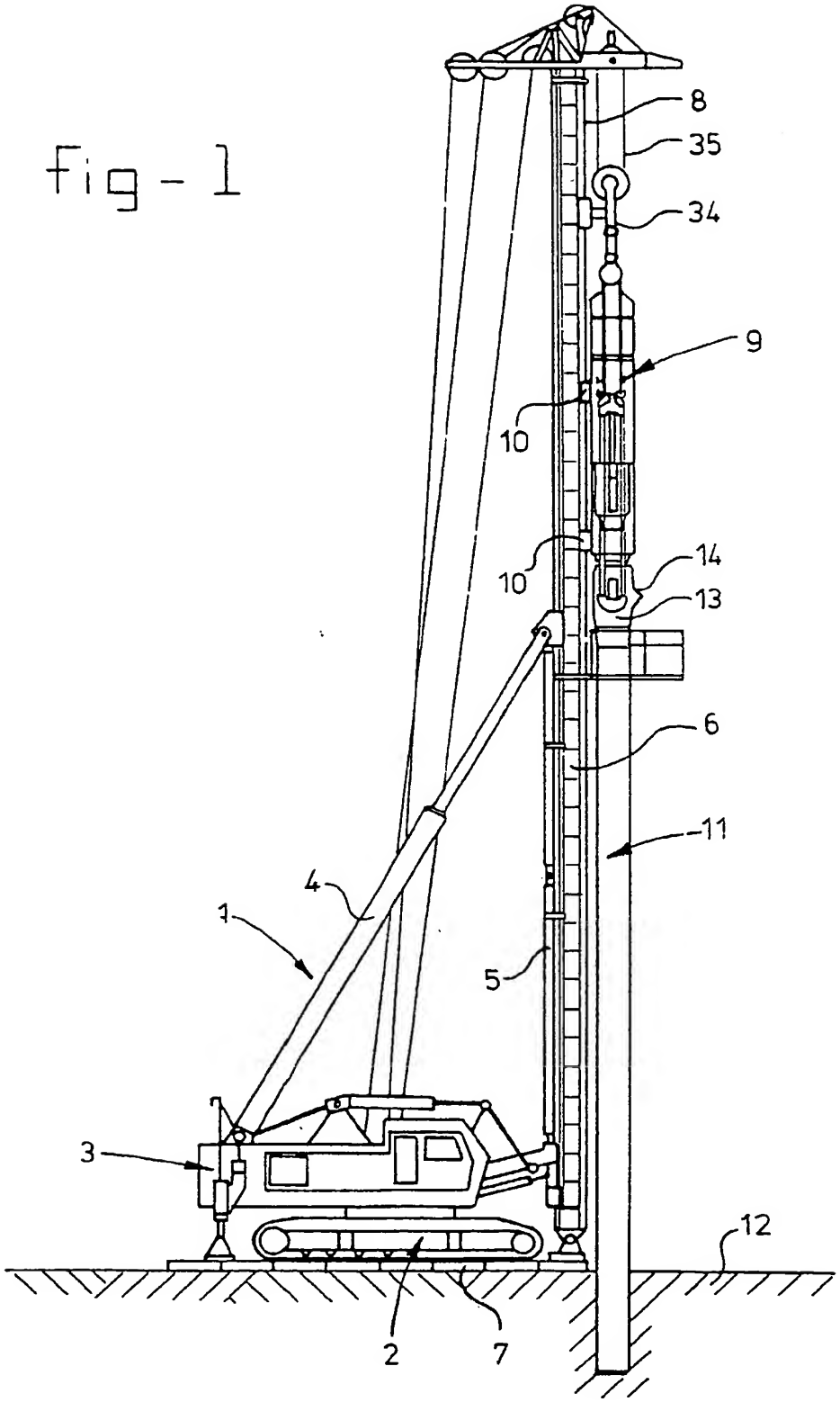


Fig - 2

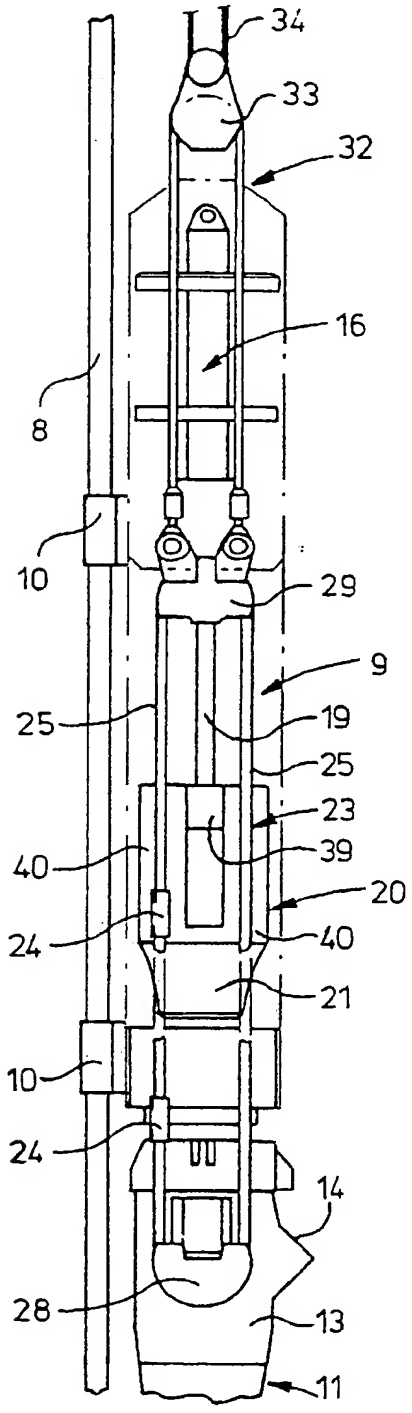


Fig - 3

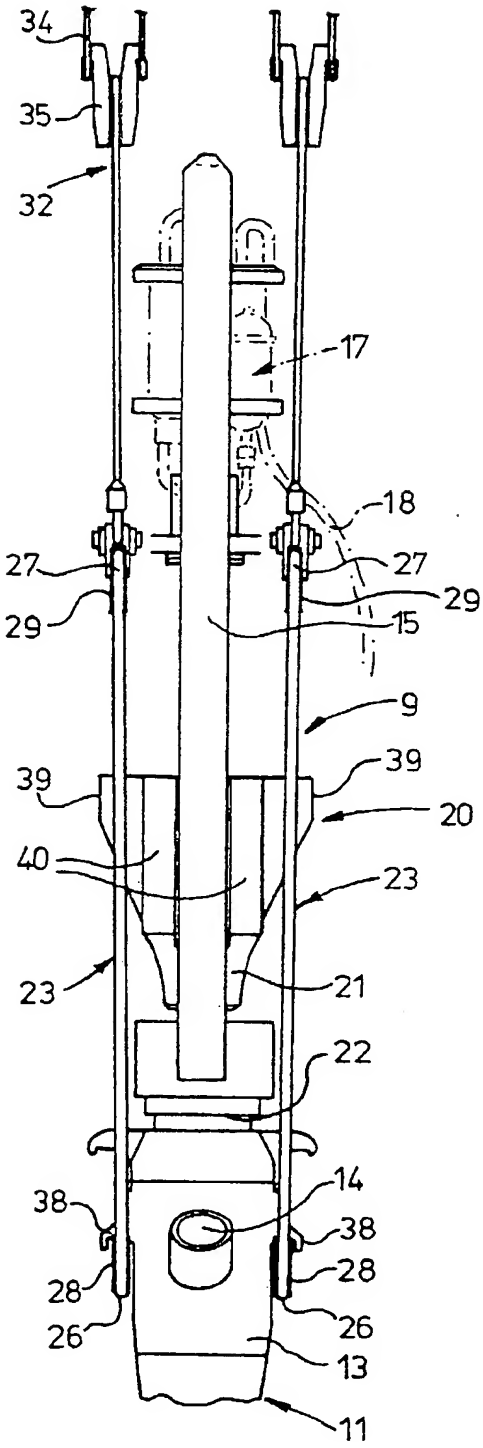


Fig - 4

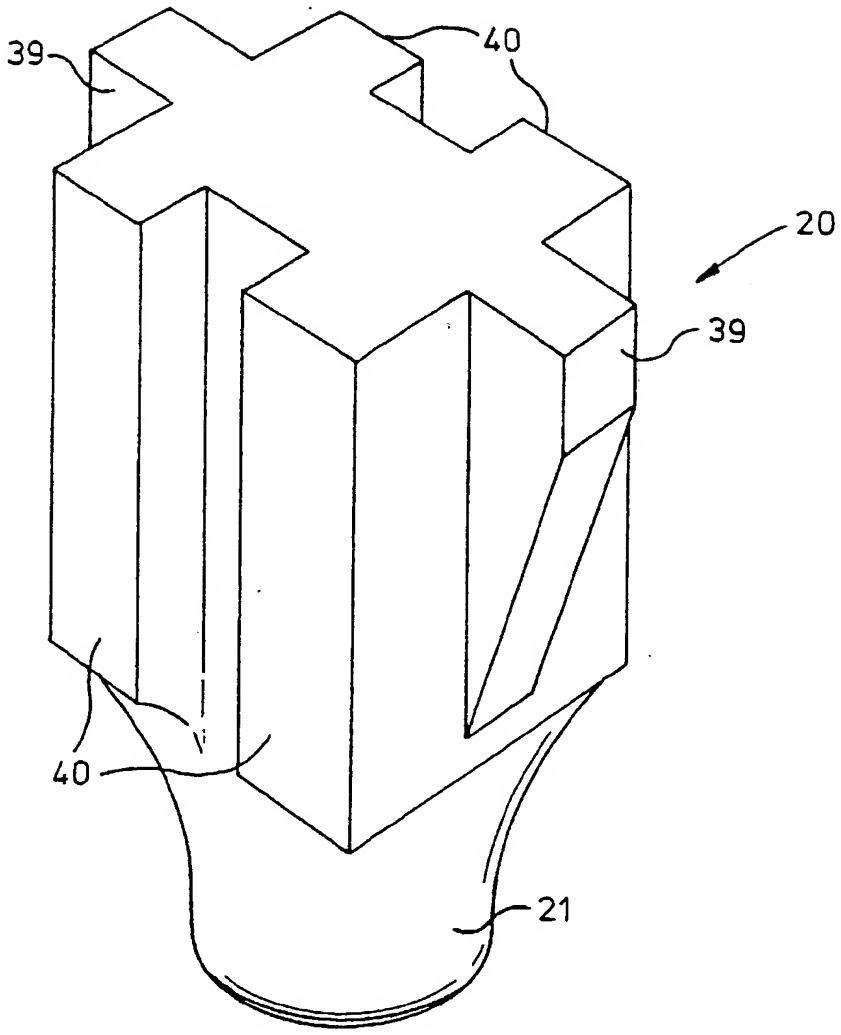
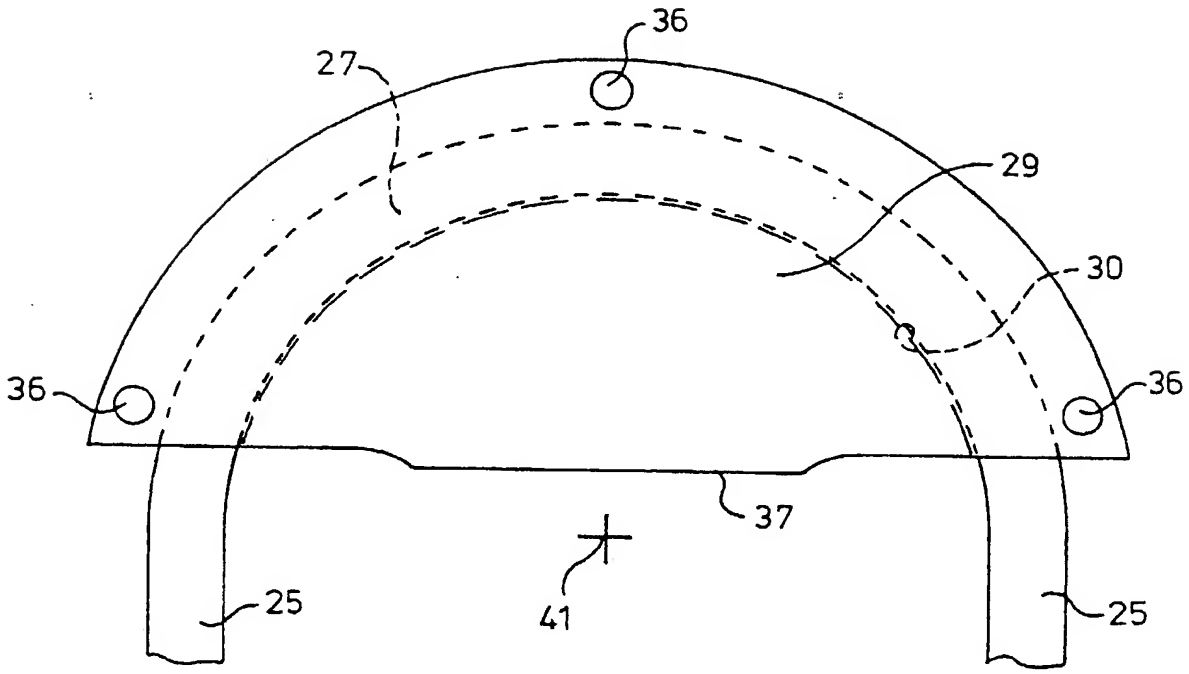


Fig - 5



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 20 0418

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	GB 1 178 962 A (THE BRITISH STEEL PILING COMPANY LTD.) 28 January 1970 * page 1, line 71 - page 2, line 15: figures *	1-7, 10-12	E02D11/00
A	GB 440 140 A (WOHLMEYER) 16 January 1936 * page 2, line 29 - line 89; figures 1-3 *	1,12	
A	NL 1 000 962 C (IHC HOLLAND NV) 8 July 1996		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 April 1998	Blommaert, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)